

Remarks

Status of the Claims

Claims 1, 5-9, 20, 22-24 and 27-29 are pending in the application, with claims 1 and 20 being the independent claims.

Summary of the Office Action

In the Office Action dated July 18, 2005, the Examiner has made five rejections of the claims. Applicants respectfully offer the following remarks to traverse each of these elements of the Office Action. Applicants respectfully request reconsideration of the present Application.

Rejection Under 35 U.S.C. § 112, First Paragraph

In the Office Action at page 2, the Examiner has rejected claims 1, 5-9, 20, 22-24 and 27-29 under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the enablement requirement. Applicants respectfully traverse this rejection.

The Examiner contends that the language in present claims 1 and 20, indicating that "the semi-permeable membrane does not permit bulk flow of liquids and solids" renders the claims non-enabled. The Examiner contends that Christy, T.M., U.S. Patent No. 5,639,956 (hereinafter "Christy") discloses that the tetrafluoroethylene polymer membrane used therein is impervious to the "bulk flow of either gases, liquids or solids," Office Action at page 2, second paragraph. The Examiner therefore concludes that, since the membrane in Christy and an exemplary membrane of the present invention are

identical, there is an inconsistency in the present specification as the functions of the two membranes are not identical, and therefore the claims are not enabled. Applicants respectfully disagree with the Examiner's contentions and conclusions.

The Examiner is directed to claim 1 of Christy at column 6:

... said polymer allowing the gas phase of at least one particular chemical compound found in the soul to permeate through said membrane from said membrane outer surface to said membrane inner surface while *substantially preventing the transfer of liquids and solids* found in said soil through said membrane . . .

Christy at Column 6, lines 21-27 (emphasis added). Applicants respectfully submit that the membrane disclosed in Christy, representative of an exemplary membrane for use in the present invention, therefore, "does not permit bulk flow of liquids *and* solids," as recited in present claims 1 and 20. The language cited by the Examiner (Christy at column 2, lines 64-65) is used to indicate that the membrane is impervious to the bulk flow of gases, impervious to the bulk flow of liquids, *and* impervious to the bulk flow of solids, i.e. it is impervious to the bulk flow of *all* of the material phases. Hence, Applicants respectfully submit that there is not an internal inconsistency in the present specification, as the Examiner contends, and in fact, both membranes are functionally identical.

The ordinarily skilled artisan would readily understand the requirements of a semi-permeable membrane that allows gas phase molecules to pass, but "does not permit bulk flow of liquids *and* solids." The ordinarily skilled artisan would also recognize that the membrane disclosed in Christy is one example of such a semi-permeable membrane. Hence, Applicants respectfully submit that the ordinarily skilled artisan would be able to

make and use at least one exemplary embodiment of the present invention, by employing the membrane disclosed in Christy. Hence, claims 1, 5-9, 20, 22-24 and 27-29 are clearly enabled. In view of the foregoing remarks, Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. § 112, first paragraph.

Rejection Under 35 U.S.C. § 103(a) Over Christy, In View of Taylor and Further In View of Robbat

In the Office Action at page 3, the Examiner has rejected claims 1, 5, 6, 8 and 22-24 as allegedly being unpatentable over Christy, in view of Taylor, B.D., U.S. Patent No. 5,411,087 (herein after "Taylor") and further in view of Robbat, Jr., A., U.S. Patent No. 6,487,920 (hereinafter "Robbat"). Applicants respectfully traverse this rejection.

The Examiner contends that Christy discloses an apparatus for sampling gas from the ground, including a semi-permeable membrane, a support and a detector. The Examiner indicates that Christy does not disclose the use of a heater, vacuum or gas chromatograph. The Examiner relies on the disclosures of Taylor and Robbat to cure these deficiencies.

The Examiner contends that it would have been obvious to use a vacuum in combination with the membrane apparatus of Christy, as Taylor discloses the use of vacuum lines to draw samples from a soil probe to an on-site chromatograph. The Examiner also contends that it would have been obvious to employ a heater in combination with the membrane apparatus of Christy, as Robbat discloses the use of a heater to heat soil surrounding a probe to facilitate sampling. Applicants respectfully disagree with the Examiner's contentions.

The semi-permeable membrane apparatus disclosed in Christy (a representative example of a membrane for use in the present invention), is characterized in Christy to be a diffusion-limited membrane. For example, in describing the time lag in detecting compounds caused by the diffusion limitations of the membrane, Christy states:

[T]his time lag arises from the time required for a compound to pass through the membrane and then be conveyed to the ground surface in the carrier gas stream. The time lag is primarily determined by the *diffusion coefficient* of the compound encountered

Christy at column 5, lines 12-16 (emphasis added). Furthermore, in describing the sampling technique, Christy states "[s]uch compounds will partition into the gas phase adjacent the outer membrane surface and *diffuse through the membrane* into the carrier gas." Christy at column 5, lines 33-35 (emphasis added). Hence, Applicants respectfully submit that the ordinarily skilled artisan would have understood the membrane disclosed in Christy to be a diffusion-limited membrane.

Applicants respectfully submit that the Examiner has provided no motivation to combine the disclosure of Christy with that of Taylor. Specifically, the Examiner has provided no reasonable expectation of success of using a vacuum line as disclosed in Taylor in combination with the diffusion-limited membrane apparatus disclosed in Christy. The ordinarily skilled artisan, based upon the disclosure of Christy, would have understood the membrane apparatus to be diffusion-limited (as discussed above). That is, permeation of gas through the membrane would not be enhanced or increased through the addition of a vacuum line to the probe. Taylor discloses the use of vacuum lines in combination with gas sampling apparatus that *do not* employ semi-permeable membranes (or any membranes for that matter). The apparatus of Christy utilizes a

carrier gas to "sweep" gas that has *diffused* through the membrane to the surface for further analysis. There is no indication in Christy that the apparatus disclosed therein could, or should, be used in combination with a vacuum line as disclosed in Taylor, as alleged by the Examiner. Hence, the Examiner has not established a *prima facie* case of obviousness based upon the disclosures of Christy and Taylor, alone or in combination.

Furthermore, Applicants respectfully submit that the ordinarily skilled artisan, based upon the disclosures of Christy and Taylor, would not have had a reasonable expectation of success to combine the semi-permeable, diffusion-limited membrane of Christy with a vacuum line as disclosed in Taylor. As noted above, permeation of gas through the semi-permeable membrane of Christy was characterized as diffusion-limited, e.g., "lag is primarily determined by the *diffusion coefficient* of the compound encountered." Christy at column 5, lines 15-17 (emphasis added). As illustrated by Fick's law -- $J = -D(\delta c/\delta x)$ -- flux (J) across a diffusion-limited membrane is determined by the diffusion coefficient (D) and the concentration gradient ($\delta c/\delta x$) of the diffusing species across the membrane. The ordinarily skilled artisan would have had no motivation to attach a vacuum line to the membrane apparatus of Christy, as application of a reduced pressure would not enhance diffusion through the membrane, since movement of gas across the membrane is limited by the *diffusion coefficient* of the compound and *not* related to any pressure gradient across the membrane. Hence, the ordinarily skilled artisan would not have had a reasonable expectation of success to make such a combination (see M.P.E.P. §§ 2142-2143).

It was not until the present invention that it was conceived to use a vacuum in combination with a semi-permeable membrane, such as that disclosed in Christy.

Through experimentation, Applicants determined that, contrary to the disclosure of Christy, the membrane disclosed therein was in fact *not* diffusion-limited, but rather a pore-flow membrane. That is, the membrane actually contains microscopic pores that allow gas to pass, rather than diffuse through the polymer itself. The hydrophobic nature of the membrane limits bulk flow of liquids, while the small pore size of the polymer membrane limits the bulk flow of solids (i.e., the membrane does not permit bulk flow of liquids *and* solids, as recited in the present claims). However, the porous nature of the membrane does allow gas to pass through the pores of the membrane. By attaching a vacuum line to the apparatus, a dramatic enhancement in detection was observed.

The Examiner's attention is directed to the Examples section of the present specification, specifically page 15 and Figures 3 and 4. Figure 3 represents the response from a gas chromatograph as mV vs. time in minutes, comparing the vacuum membrane extraction system of the present invention and the same membrane (i.e. the membrane disclosed in Christy) without vacuum (sweeping system). As noted in Figure 3, the addition of vacuum extraction to the semi-permeable membrane increased the peak height (directly related to the amount of sample transferred from the sample site to the gas chromatograph) by nearly 80 fold. Figure 4 represents data of the peak area over time for both vacuum and sweeping systems. The data indicates a dramatic enhancement of nearly 40 times in peak area, a direct measure of the increase in sample extraction resulting from the use of the vacuum extraction system of the present invention.

Applicants respectfully submit that this data clearly represents an unexpected enhancement in gas sample recovery and sensitivity provided by the apparatus and methods of the present invention. The ordinarily skilled artisan, guided by the

disclosures of Christy and Taylor, would have had no expectation of success, and hence no motivation, to attach a vacuum line to the membrane apparatus of Christy. The ordinarily skilled artisan would never have considered combining a vacuum line, as disclosed in Taylor, with membrane characterized as diffusion-limited membrane, as in Christy. As shown in Fick's law above, an increase in the pressure gradient would have no effect on a membrane in which flux across it is controlled by the diffusion coefficient of the diffusing species. Hence, not only has the Examiner failed to provide any motivation to combine the disclosures of Christy and Taylor, but the ordinarily skilled artisan would have had no reasonable expectation of success to combine such disclosures. The dramatic, unexpected benefits discovered by Applicants provide further evidence of the non-obviousness of the presently claimed invention.

With regard to Robbat, Applicants submit that this reference does not disclose the use of a semi-permeable membrane. Rather, the soil probe of Robbat utilizes open ports to collect sample gas (*see e.g.*, Robbat at column 5, lines 11-25). The ordinarily skilled artisan would not have been motivated to use the heating cartridge disclosed in Robbat in combination with the membrane apparatus of Christy. Christy does not indicate that any heating is required to volatilize gasses for sampling. In fact, Christy indicates that "compounds typically will exhibit a vapor pressure *at ambient temperature.*" Christy at column 5, lines 37-39 (emphasis added). Hence, there is no motivation to utilize the heating cartridge disclosed in Robbat in combination with the membrane apparatus disclosed in Christy, as Christy clearly indicates that the membrane is designed to sample gases that are volatile (i.e. have a vapor pressure) at ambient temperature (i.e. the temperature of the sample site). In addition, Robbat does not disclose the use of a

vacuum line in combination with a membrane apparatus, and hence, does not cure the deficiencies noted above in Christy and Taylor.

In view of the foregoing remarks, Applicants respectfully submit that the Examiner has not established a *prima facie* case of obviousness. Reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a) over Christy, in view of Taylor and further in view of Robbat are respectfully requested.

Rejection Under 35 U.S.C. § 103(a) Over Christy, In View of Taylor, and Further In View of Robbat and Traina

In the Office Action at page 3, the Examiner has rejected claim 7 as allegedly being unpatentable over Christy, in view of Taylor, and further in view of Robbat and Traina, J.E. and Myers, R., U.S. Patent No. 5,297,432 (hereinafter "Traina"). Applicants respectfully traverse this rejection.

The Examiner contends that it would have been obvious to employ a chiller upstream of the membrane analyzer disclosed in Christy, because Traina discloses the use of a chiller to allow for gas concentration measurements on a dry basis. Applicants respectfully disagree with the Examiner.

The disclosure of Traina is directed to systems for analysis of gasses or fossil fuel combustive gasses being vented through a stack (*see* Traina at column 1, lines 7-10). Traina is not directed to sampling of gases below a soil surface. Hence, Traina represents non-analogous art to the present invention, as well as the disclosures of Christy, Taylor and Robbat. Applicants respectfully submit that Traina does not disclose an apparatus comprising a semi-permeable membrane and a vacuum source, as recited in

the presently claimed invention. Hence, Traina does not cure the deficiencies in Christy, Taylor and Robbat noted above.

Furthermore, there is no indication in the disclosure of Christy that a chiller would be required to cool sampled gases prior to analysis. Gas sampling disclosed in Christy occurs at ambient temperature (as noted above), whereas the gases sampled in Traina are heated to about 250°F prior to analysis (*see* Tirana '432 at column 2, lines 28-30). The Examiner has provided no motivation to support the use of a chiller as disclosed in Traina in the system of Christy. Furthermore, there is no reason to think that the gases sampled in Christy, at ambient temperature, would require cooling to dry the samples (the purpose of the chiller employed in Traina). Therefore, Applicants respectfully submit that the Examiner has not established a *prima facie* case of obviousness. Reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a) are respectfully requested.

Rejection Under 35 U.S.C. § 103(a) Over Christy, In View of Taylor, and Further in View of Robbat and Neal

In the Office Action at page 4, the Examiner has rejected claim 9 as allegedly being unpatentable over Christy, in view of Taylor, and further in view of Robbat and Neal, D.M., U.S. Patent No. 6,649,129 (hereinafter "Neal"). Applicants respectfully traverse this rejection.

Applicants respectfully submit that while Neal may disclose the use of a sample loop in combination with a gas chromatograph, this reference does not cure the other deficiencies noted above in Christy, Taylor and Robbat, and hence, a *prima facie* case of

obviousness has not been established. Reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a) are respectfully requested.

Rejection Under 35 U.S.C. § 103(a) Over Christy, In View of Taylor, and Further In View of Robbat and Neal

In the Office Action at page 4, the Examiner has rejected claims 20 and 27-29 as allegedly being unpatentable over Christy, in view of Taylor, and further in view of Robbat and Neal. Applicants respectfully traverse this rejection.

As discussed above, Applicants respectfully submit that the deficiencies in Christy are not cured by the disclosures of Taylor, Robbat or Neal, alone, or in combination. The Examiner has provided no motivation to combine the disclosure of Christy and Taylor, and in addition, the ordinarily skilled artisan would have found no expectation of success to combine their disclosures to generate an apparatus as disclosed in claim 1, or a method as disclosed in claim 20. Robbat and Neal do not cure the deficiencies in Christy and Taylor, and hence, a *prima facie* case of obviousness has not been established by the Examiner. Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a).

Conclusion

All of the stated grounds of rejection have been properly traversed, rendered moot or otherwise overcome. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections and that they be withdrawn.

In the event the Examiner determines that the present application is not in condition for immediate allowance, Applicants respectfully request that Examiner contact the undersigned at the number provided in order to schedule an interview.

Applicants believe that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

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Date: November 18, 2005

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